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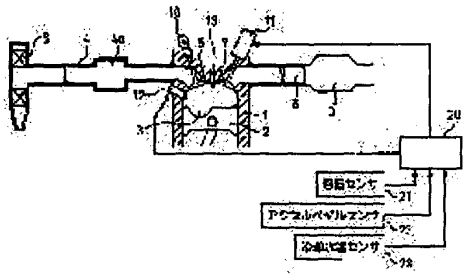
(54) CYLINDER FUEL EJECTION TYPE INTERNAL COMBUSTION ENGINE

(57)Abstract:
PURPOSE: To supply secondary air to an exhaust passage without necessitating popular secondary air pulse induction system having a pump and the like.
CONSTITUTION: This device is provided with discharging means 7, 11, 20 for discharging a part of new air supplied into a cylinder in an intake stroke to an exhaust passage 6 by piston operation in the initial period of a compressing stroke, and fuel supplying means 12, 20 for supplying fuel into the cylinder so as to realize a desired air fuel ratio against rest new air in an after compressing stroke.



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* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The cylinder-injection-of-fuel formula internal combustion engine characterized by providing an eccrisis means to discharge to a flueway a part of new mind supplied into the cylinder in the intake stroke by piston operation in early stages of a compression stroke, and a fuel-supply means to supply fuel into a cylinder so that a request air-fuel ratio may be realized to the remaining new mind in a subsequent compression stroke.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the cylinder-injection-of-fuel formula internal combustion engine which injects fuel into a direct cylinder.
[0002]
[Description of the Prior Art] In recent years, it is in the inclination for eccrisis regulation of the injurious ingredient of exhaust gas to become severe, and, for the reason, to reduce the injurious ingredient generated in a combustion chamber is desired. Among injurious ingredients, although a nitrogen oxide can reduce the yield good by making exhaust gas recycle to a combustion chamber in order that combustion temperature may fall with the big heat capacity which the inert gas which is the principal component of exhaust gas has, a practical yield reduction means does not exist about a hydrocarbon and a carbon monoxide, but a oxidation catalytic converter needs to purify it good.
[0003] Although sufficient quantity of oxygen is required and it is possible to make the gaseous mixture of a combustion chamber into RIN from theoretical air fuel ratio for this reason in order to oxidize mostly altogether the hydrocarbon and carbon monoxide which are contained in exhaust gas by the oxidation catalytic converter, since combustion gets worse, it is not practical. Therefore, preparing the pulse air induction reactor for introducing the secondary air into the upstream of the oxidation catalytic converter of a flueway generally, and making the secondary air mix in the exhaust gas burned in theoretical air fuel ratio is proposed.
[0004]
[Problem(s) to be Solved by the Invention] Since it has a pump for feeding the secondary air to a flueway, such a pulse air induction reactor makes an internal combustion engine it to be not only quite expensive, but enlarge. Therefore, the purpose of this invention is to enable supply of the secondary air in a flueway, without needing the general pulse air induction reactor which has a pump etc. in a cylinder-injection-of-fuel formula internal combustion engine.
[0005]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the cylinder-injection-of-fuel formula internal combustion engine by this invention is characterized by providing an eccrisis means to discharge to a flueway a part of new mind supplied into the cylinder in the intake stroke by piston operation in early stages of a compression stroke, and a fuel-supply means to supply fuel into a cylinder so that a request air-fuel ratio may be realized to the remaining new mind in a subsequent compression stroke.
[0006]
[Function] In order that the above-mentioned cylinder-injection-of-fuel formula internal combustion engine may discharge a part of new mind before an eccrisis means is supplied into a cylinder in an intake stroke and fuel is supplied by the fuel-supply means to a flueway as the secondary air by piston operation in early stages of a compression stroke, the pulse air induction reactor which has a pump etc. on the occasion of the secondary air supply to a flueway is unnecessary.
[0007]
[Example] Drawing 1 is the outline cross section showing the first example of the cylinder-injection-of-fuel formula internal combustion engine by this invention. In this drawing, 1 is the combustion chamber where a cylinder and 2 were formed in the piston and 3 was formed in the top face of a piston 2. 4 is an inhalation-of-air path which leads into a cylinder through an inlet valve 5, and 6 is a flueway which leads into a cylinder through an exhaust valve 7. The inhalation-of-air path 4 of each cylinder joins by surge tank 4a, and leads to the atmosphere through the air cleaner 8 located in the best style section.
[0008] The flueway 6 of each cylinder joins and is wide opened through the oxidation catalytic converter 9 to the atmosphere. Although the valve gear of an inlet valve 5 can use the general thing using the cam 10 rotated

synchronizing with a crankshaft, the valve gear 11 of an exhaust valve 6 enables opening and closing of an exhaust valve 6 at a free stage using electromagnetic force or oil pressure. Since such a valve gear is already well-known, although detailed structure is omitted, an exhaust valve can be made to be able to open against the spring energized in the valve-closing direction by, for example, supplying oil pressure to the oil hydraulic cylinder directly linked with the exhaust valve, and the mechanism in which an exhaust valve is made to close according to this spring force can be used by opening oil pressure.

[0009] 12 is a fuel injection valve for injecting direct fuel into a cylinder, and 13 is an ignition plug. 20 is a control unit which takes charge of the fuel injection timing in a fuel injection valve 10 and fuel-oil-consumption control, and opening-and-closing stage control of the exhaust valve 7 by the valve gear 11, and the cooling coolant temperature sensor 23 grade for detecting the accelerator pedal sensor 22 and cooling water temperature for detecting the stroke of an accelerator pedal as the rotation sensor 21 for detecting, each sensor, for example, the engine rotational frequency, for determining engine operational status, and an engine load is connected.

[0010] Drawing 2 is a timing diagram which shows the opening-and-closing stage of the exhaust valve 7 controlled by the opening-and-closing stage and control unit 20 of an inlet valve 5. An inlet valve 5 is opened and closed by the cam 10 synchronizing with a crankshaft so that it may open from the degree theta 1 of the 1st crank angle just behind the exhaust air top dead center TDC1 and the valve may be closed with the degree theta 2 of the 2nd crank angle just behind the inhalation-of-air bottom dead point BDC1. On the other hand, an exhaust valve 7 is added to the 1st opening and closing of the fixation which is opened from the degree theta 3 of the 3rd crank angle in front of the expansion bottom dead point BDC2, and is closed with the degree theta 4 of the 4th crank angle just behind the exhaust air top dead center TDC1. The valve gear 11 which can be changed freely is utilized, an opening-and-closing stage is opened from the inhalation-of-air bottom dead point BDC1, and the 2nd opening and closing closed with the degree theta of the 5th crank angle in the compression stroke determined by the control unit 20 are performed.

[0011] The degree theta of the 5th crank angle is determined that the inhalation-of-air bottom dead point BDC1 is made in agreement when it is brought close to the inhalation-of-air bottom dead point BDC1 and the amount of the maximum inhalation of air is needed so that there are many amounts of required inhalation of air which become settled according to the engine operational status based on the output of each above-mentioned sensor, namely, the 2nd opening and closing are not performed by the control unit 20.

[0012] Thus, if an inlet valve 5 and an exhaust valve 7 are opened and closed, since an exhaust valve 7 is opened and the inlet valve 5 is closed just behind the exhaust air top dead center TDC1, some exhaust gas discharged by the flueway 6 with descent of a piston 2 is inhaled into a cylinder, and the internal exhaust gas recirculation is performed. Then, an inlet valve 5 is opened just before or after an exhaust valve 7 being closed, and new mind is inhaled from the inhalation-of-air path 4 into a cylinder to the inhalation-of-air bottom dead point BDC1.

[0013] Next, when an exhaust valve 7 is opened again, a part of inhalation of air in a cylinder (new mind that exhaust gas was mixed at a predetermined rate) is discharged to a flueway 6 with a rise of a piston 2 and it becomes an initial complement in the present engine operational status, an exhaust valve 7 is closed and compression is started. The fuel injection by the fuel injection valve 10 is started from immediately after this valve closing of an exhaust valve 7, and the fuel of the amount which realizes theoretical air fuel ratio to new **** which remains in a cylinder is injected, and it ends. In this fuel injection, since the valve-closing time of the exhaust valve 7 in the 2nd opening and closing is rash in the time with many amounts of inhalation of air, a lot of fuel can be injected.

[0014] Then, ignition by the ignition plug is performed just before the compression top dead center TDC2. Since combustion in the combustion chamber 3 formed in piston 2 top face is started, an exhaust valve 7 is opened from the degree theta 3 of the 3rd crank angle in front of the expansion bottom dead point BDC2 and the valve is closed with the degree theta 4 of the 4th crank angle just behind the exhaust air top dead center TDC1 The exhaust air to a flueway 6 is performed with a rise of a piston 2 from the expansion bottom dead point BDC2 to the exhaust air top dead center TDC1.

[0015] this combustion -- theoretical air fuel ratio -- since it is combustion of a gaseous mixture, it is good, and since exhaust gas is inhaled into the cylinder in the early stages of an intake stroke, combustion temperature is lowered by the big heat capacity, and the amount of nitrogen oxides to generate is reduced considerably On the other hand, although it usually passes along a carbon monoxide and a hydrocarbon and they are generated In order to make into a RIN state the exhaust gas which a part of inhalation of air is discharged by the flueway 6 in the compression stroke, and sets like an exhaust air line and is discharged by the flueway 6 from theoretical air fuel ratio in the upstream of a oxidation catalytic converter 9 All are mostly purified by the oxidation catalytic converter 9 using sufficient quantity of oxygen, and the carbon monoxide and hydrocarbon which are contained in exhaust gas can carry out the remarkable improvement of the exhaust air emission by it. Furthermore, since a throttle valve is not used for control of new **** according to engine operational status, a pumping loss cannot occur but the part engine generating torque can be

increased.

[0016] Moreover, in the timing diagram mentioned above, as a dotted line shows, the valve-closing stage in the 1st opening and closing of an exhaust valve 7 It is also possible to consider as degree of 4th crank angle theta4' in front of the exhaust air top dead center TDC1. by that cause For some exhaust gas to remain into a cylinder like an exhaust air line, and have the reduction effect of the nitrogen oxide same as exhaust gas recirculation as the above-mentioned in addition, the exhaust gas which it leaves into a cylinder Since it is maintained by high temperature as compared with once discharging to a flueway 6, the evaporation state of the fuel which the intake-air temperature in a fuel-injection start time became high, and was injected improves, and the rate of combustion is rash, and let combustion be a still better thing.

[0017] In the timing diagram mentioned above, the opening-and-closing time in the 1st opening and closing of an exhaust valve 7 is being fixed, and, thereby, the exhaust gas of a predetermined rate is mostly mixed in the gaseous mixture at the time of combustion in each engine operational status. However, as for the exhaust gas recirculation, it is desirable to decrease the mixing rate of exhaust gas with some combustion aggravation at the time of the engine heavy load which needs high power, and an engine low load with unstable combustion, therefore it is also possible to change the valve-closing time in the 1st opening and closing of an exhaust valve 7 using a valve gear 11 according to engine operational status, so that the mixing rate of such exhaust gas may be realized.

[0018] Drawing 3 is the outline cross section showing the second example of the cylinder-injection-of-fuel formula internal combustion engine by this invention. The upper part in a cylinder and the upstream of the oxidation catalytic converter 9 of a flueway 6 are opened for free passage by the free passage way 30, as for the difference from the first example shown in drawing 1 , the control valve 31 is arranged on this free passage way 30, especially the thing of the valve gear of an exhaust valve 7 that can be changed freely is unnecessary in opening-and-closing time, and the cam which synchronizes with the crankshaft set up so that the 1st opening and closing of the above-mentioned timing diagram might be realized is used.

[0019] Opening-and-closing control of the control valve 31 arranged on the free passage way 30 is carried out by control unit 20' like the 2nd opening and closing of the exhaust valve 7 in the above-mentioned timing diagram. Therefore, by this example as well as the first example, a piston 2 can be made to discharge a part of new mind inhaled in the intake stroke to a flueway 6 with a rise in a compression stroke, and the secondary air can be supplied to a flueway, without needing the general pulse air induction reactor which has a pump etc.

[0020] Not only in as this invention was mentioned above, when supplying the secondary air to a flueway by all engine operational status, for example, in order to realize early warming up at the time of starting between the colds of the three-way-component-catalyst converter arranged in the flueway The unburnt fuel in combustion by the rich gaseous mixture so that it may be made to burn altogether by the three-way-component-catalyst converter The exhaust gas recirculation as a means for being able to use, when restricting at this time and supplying the secondary air to a flueway, therefore reducing the yield of a nitrogen oxide does not limit this invention.

[0021]

[Effect of the Invention] According to the cylinder-injection-of-fuel formula internal combustion engine by this invention, thus, a discharge means In order to discharge to a flueway as the secondary air by piston operation in early stages of a compression stroke, a part of new mind before it is supplied into a cylinder in an intake stroke and fuel is supplied by the fuel-supply means The general pulse air induction reactor which has a pump etc. on the occasion of the secondary air supply to a flueway is unnecessary, and can prevent enlargement of the internal combustion engine brought about by a cost rise and pulse air induction reactor of the part.

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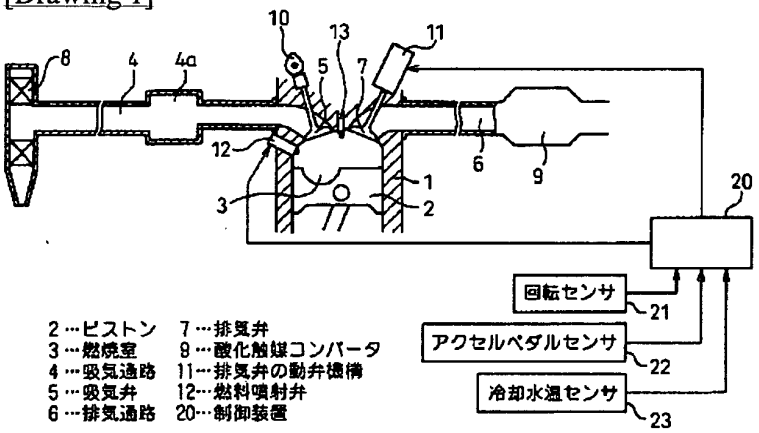
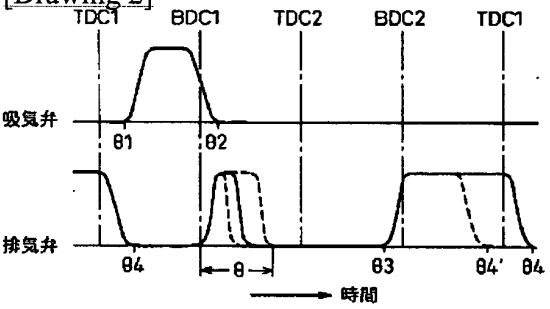
* NOTICES *

DRAWINGS

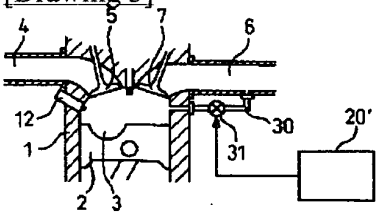
[Drawing 1]



[Drawing 2]



[Drawing 3]



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